# CURRENT STATUS OF SAFETY ANALYSIS REPORTS IN THE CZECH REPUBLIC

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## 1. INTRODUCTION

Legislative process regulating industrial utilisation of nuclear energy was launched by the amendment to the Law No. 50/1976 Coll., on Land Planning and Construction Regulations (the Construction Act) and its implementing regulations No. 83/1976 Coll., on Construction Documentation and No. 85/1996 Coll., on More Detailed Regulation of Area Management and Construction Regulations. The Construction Act of 1976 established for the first time that construction of a nuclear installation shall require the special approval of the Regulatory Body (ČSKAE at that time). Regulation No. 85/1976 Coll. defined the types and content of Safety Analyses Reports required by the ČSKAE as a basic information necessary for the issuance of its consents and Regulation No. 83/1976 Coll. established that three types of Safety Analysis Reports shall be an integral part of the documentation of constructions with nuclear installations:

- Siting (Initial) Safety Analysis Report - for site permit,
- Preliminary Safety Analysis Report - for construction permit,
- Pre-operational Safety Analysis Report - for operational permit.

## 2. NUCLEAR POWER PLANTS SAFETY ANALYSIS REPORTS

### 2.1 Temelín NPP

The General Safety Analysis Reports (GSAR) for the original Soviet design of the Czech NPPs were evaluated by the Czechoslovak Atomic Energy Commission in the 70-ties and 80-ties. Evaluation of the Preliminary Safety Analysis Report (PSAR) was conducted. It resulted in the Commission decision on its consent with the construction permit issuance.

In the early 90-ties a decision was taken to modify the original NPP Temelín design. In view of these changes that would definitely have significant impact on the results of the original plant design licensing assessment, Regulatory Body took a position that Amendment to the original PSAR shall be generated and submitted to SÚJB for evaluation. It was further agreed that the Amendment should follow the format and contents of PSAR as specified in the US NRC Regulatory Guide 1.70. Following this, the Regulatory Body decided to evaluate this Amendment trough a process based on the guidance provided in the US NRC Standard Review Plan (NUREG-0800). A formal licensing procedure was drafted and implemented for NPP Temelín regulatory licensing assessment.

As a result of this, NPP Temelín licensing team has been established by the Regulatory Body chairman appointment. It is composed of the Regulatory Body professional staff members and it is headed by a project manager. There is a leading person on this team with primary responsibility for licensing assessment to be performed in each individual technical area. This team is supported by experts from the Nuclear Research Institute in Řež

and other independent organisations and individuals. US AID funded and US NRC managed assistance program "US Licensing Technology Transfer to the Czech Republic" which has been launched to provide training of the team members and the outside experts in licensing assessment of the above-specified parts of the PSAR.

Since the very beginning of the NPP Temelín design modification project, regular and effective communication has been established between SÚJB and licensee. As an example, for the two major modification efforts (plant I&C systems and fuel and subsequently core design change) and new safety analysis (PSAR chapter 15), they have the following forms:

- Regulator is kept informed on the design intentions as well as on results of the progress made in the design of individual modifications. This is usually accomplished trough presentations given by supplier Westinghouse Electric Company (WELCO) design and analysis staff to the licensing team and experts from the supporting organisations followed by informal discussions on technical and regulatory aspects of the presented information,
- A series of the so-called "Topical Report" generated by supplier has been submitted to the Regulator for consideration and evaluation. In case of I&C these reports address some safety related issues of more general nature (such as I&C equipment qualification methodology, reliability analysis of I&C systems, implementation of diversity and defence-in-depth within the I&C area, compliance with some design criteria, software verification and validation methodology, etc. or provide more detailed information on the design of individual I&C systems such as the primary reactor protection system, diverse protection system, reactor control and limitation system, etc.). Topical Reports are not official licensing submittals as per the Czech Republic regulatory legislation and practice. They include information which is considered by the designer/supplier as proprietary, therefore, they are not public documents,
- Sequential revisions of relevant chapters or sections of the PSAR are submitted to SÚJB for review and evaluation prior to the submission of the final version of the PSAR Amendment,
- Requests for Additional Information (RAIs) are communicated to the designer/supplier via the licensee. Evaluation of above-mentioned documentation usually results in findings and raising formal, i.e. in writing, questions – RAIs. Formal responses to the RAIs are assessed for adequacy and completeness and provide a basis for completion of evaluation finding. This process is usually repeated in several cycles.

As a pilot project, the licensing assessment of the Amendment to the NPP Temelín PSAR Chapter 4 (Reactor), Chapter 7 (I&C systems) and Chapter 15 (Safety analyses) is being performed. Database ISSUES (an MS ACCESS 97 application) of technical requirements was created as an auxiliary tool for the licensing process. This so called "licensing database" has been developed by the Regulatory Body staff within the already mentioned assistance program "US Licensing Technology Transfer to the Czech Republic" to serve the following purposes:

- to specify and record all licensing issues which will have to be addressed in the licensing review of the fuel, I&C and accident analyses related safety documentation submitted to the Regulatory Body,
- to record evaluation of individual licensing issues and generated RAIs,
- to keep track of the licensee's response to individual RAIs, i.e. to record the response as well as its evaluation and new RAIs, if any,

- to provide an efficient and flexible tool for managing the licensing process, e.g.
  - to get quickly a precise picture of the actual status of the process in terms of how many issues have been evaluated, how many of them remain "open" and how many have been "closed", how many RAIs have been raised and to what topics, etc.,
  - to use the database information in decision making with respect to licensing project resources allocation, focusing attention on bottlenecks, planning future activities, etc.

The Pre-Operational Safety Analysis Report ( in western countries called Final Safety Analysis Report ) was submitted to the SÚJB in compliance with Czech legislation. The report content was performed based on the USNRC R.G.1.70 and reviewed through the same way as PSAR Amendment.

## 2.2 Dukovany NPP

The first complete reassessment of nuclear safety (innovated Pre-operational SAR) for the Dukovany units was performed after 10 years of operation using advanced state-of-the-art tools and taking into account operational experience and plant modifications. It was prepared by the utility to fulfil one of the condition of the State Regulatory Body from its decision No. 154 (1991), which established conditions for the 1st unit license for continued operation after 10 years. On the basis of this innovated Operational Safety Analysis Report, the State Regulatory Body by its decision No. 197 (in August 1995) has issued 2 year license for the continued operation of Dukovany 1st unit subject to fulfilment of 97 requirements. One of the conditions requires continually updating ("Living") Operational Safety Analysis Report. Dukovany NPP OSAR is annually updated. "Living" (periodically updated) Operational Safety Report is now in effect. It documents the status of nuclear safety assurance of the NPP Dukovany units. This report consists of constant unchangeable part (the same for all 4 NPP Dukovany units) as well as of the parts which are updated regularly once a year, always not later than by the end of the next half-year - at the same time for all units. This safety report is based on the complemented "Operational Safety Report for Nuclear Power Plant Dukovany 1st Unit".The syllabus and content of single chapters were negotiated between the regulatory authority and NPP based on ČSKAE Guide No. 5/1988 "Contents of SARs". The ideas included in the Guide No.5 might be provided through description of OSAR content as follows:

Introduction

- syllabus of the whole document
- list of authors
- list of abbreviations

Vol. 1 – Technical Introduction

- assessment of NPP operation
- overview of modifications which were done

Vol. 2 – Safety Principles and Criteria

- design safety criteria

- list of standards
- comparison of NPP Dukovany design with similar ones

Vol. 3 – Site Characteristics

- new data in hydrological, geological, meteorological and demographical situation in NPP neighbourhood

Vol. 4 – Description of Systems and Equipments Important to Safety

- classification and description of safety systems and components
- new calculation of neutron - physics characteristics
- thermohydraulic characteristics
- shielding characteristics
- systems and components stability and life - time characteristics

Vol. 5 – Accident Analysis

Contents analysis of possible events and accidents caused by

- reactivity changes
- primary coolant failures
- secondary heat – removal failures
- loss of primary coolant
- loss of secondary coolant
- electrical failures
- fires
- internal floods
- external hazards
- failures during reload

Vol. 6 – NPP

- organisation
- inspection system
- maintenance tests
- emergency preparedness
- decommissioning

Vol. 7 – Quality Assurance Programs

- NPP QA system

Vol. 8 – Conclusions

- general assessment of plant safety based on the contents of previous chapters
- recommendations for the improvements

## 2.3 Regulatory position and practices concerning review activities.

The licensing process for first Temelín unit is under way. A special situation developed as for the completion of the Temelín NPP technical equipment from different countries (e.g. Westinghouse Electric Company was contracted to supply the reactor fuel, instrumentation and control), designed and manufactured at different times, have to be integrated.
It is obvious that Czech codes and standards must be unconditionally met. Another obligatory condition was not to disturb other parts of the design (design's compatibility and design's reliability).
Safety assurance for safety-related items (e.g. fuel system) has to be demonstrated by submitting complete documentation (as a Supplements to the Safety Report and Topical Reports) from the point of view of the design's compatibility with other components and parts taking into account existing (original) materials, moderator (water chemistry), especially from the standpoint of:

- thermal hydraulic properties - vibration, hydraulic resistance, CHF correlation, fuel rod bowing, effect of spacing grids, pressure losses,
- mechanic properties - rigidity, cyclic fatigue, wear, cladding abrasion, deformation by external forces (load during LOCA and seismic events), kinetics of control assemblies drop,
- chemical properties - corrosion, hydriding,
- neutronic-physical properties - peaking factors, influence of different enrichment, water-uranium ratio, etc.; shutdown reactivity margin; stability; maximum speed of the reactivity insertion, both calculated and experimental (especially for non-active tests area).

Design's reliability and safety related influence has to be demonstrated by proving that:

- fuel design parameters will not be exceeded,
- fuel cooling will be ensured,
- coolability is always maintained
- core design neutronic parameters will be met for normal and abnormal operation and accident conditions

In addition to this State Regulatory Body (State Office for Nuclear Safety) requested the deliverables to be licensable in the country of origin i.e. to meet the national codes and standards.

As the possibility to adopt any set of criteria or limits which would assure fulfilment of general requirements to protect public health and safety and general design requirements is opened by Czech legislative, the key decision to use US NRC Licensing Review Process for the SAR parts concerning fuel, I&C and accident analysis was taken.

SÚJB as a Regulatory Body is engaged on further activities supporting the correctness of the review of safety documentation. Important one is focused on calculational program's qualification. The verification of the adequacy of the code used to perform calculation to assess properties of the plant is the main goal. Groups of the experts in the given field are formed. They are nominated by the Chairman of SÚJB. No fill-in is permitted, they are supposed to express their opinion as independent experts and not acting as representative of maternal organisation. There is a possibility to invite another experts (without right to vote). According to the field of expertise 7 group have been formed:

1. Core characteristics calculation

2. Fuel rod /fuel assembly behaviour
3. Thermo-hydraulic analysis of transients
4. Beyond DBA
5. Stress and strain component analysis
6. Radionuclid transport and Source term calculation
7. Reliability analysis and probabilistic safety assessment (PSA)

Based on documentation required for the Code Qualification Procedure, on the chosen opponent's review of the code under question and on the opinion of the expert group members the suitability of the code for solving the analysis is being assessed.
Experiences gained during the Temelín licensing process were applied also for licensing process of the new fuel for Dukovany plant.

A new revision of Safety Analysis Report is under review process now as substantial parts (fuel system design, nuclear design, thermal and hydraulic design, accident analysis) reflect introduction of the new (advanced) Russian fuel. SÚJB has already started the review of the OSAR first parts related to the I&C design changes at Dukovany NPP.

## 3. Conclusions

Presented paper gave the comprehensive overview on current status of the SARs in the Czech Republic. I believe the scope and depth of information provided in different SARs correspond to the internationationaly recognised practices in the field.

The practices of the licensing process are considered to be on a high level, the review is very thorough and is well documented. The use of database of safety issues, requirements, requests for additional information and licensee responses is very progressive way of filling system and keeping traceback.

REFERENCES

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